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NATIONAL DAM SAFETY PROGRAM. VALLEY WATER MILLS DAM (MO 20035),--ETC(U)
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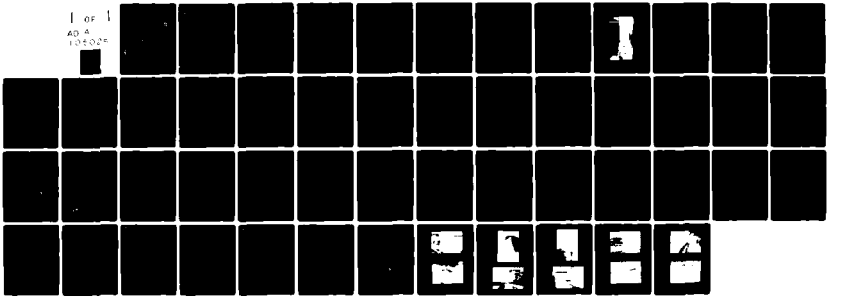

LEVEL II

MISSOURI - OSAGE - GASCONADE BASIN

AD A103025

VALLEY WATER MILLS DAM

GREENE COUNTY, MISSOURI

MO 20035

PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY INSPECTION

*Original contains color plates: All DTIC reproductions will be in black and white.

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

MAY 1980

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A105 025 / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Valley Water Mills Dam (MO 20035) Greene County, Missouri	5. TYPE OF REPORT & PERIOD COVERED Final Report / 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) L. Robert Kimball and Associates	8. CONTRACT OR GRANT NUMBER(s) DACW43-79-C-0034
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101	10. ~~PROGRAM ELEMENT, PROJECT~~, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101	12. REPORT DATE May 1980 / 13. NUMBER OF PAGES Approximately 45
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report) UNCLASSIFIED / 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

National Dam Safety Program. Valley Water Mills Dam (MO 20035), Missouri - Osage - Gasconade Basin, Greene County, Missouri. Phase I Inspection Report.

Approved for release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

VALLEY WATER MILLS DAM

GREENE COUNTY, MISSOURI

MISSOURI INVENTORY NO. 20035

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY

L. ROBERT KIMBALL AND ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS
EBENSBURG, PENNSYLVANIA

UNDER DIRECTION OF

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

MAY 1980

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Valley Water Mills Dam Phase I Inspection Report.

This report presents the results of field inspections and evaluations of Valley Water Mills Dam (20035).

This report was prepared under the National Program of Inspection of Non-Federal Dams.

Valley Water Mills Dam has been classified as unsafe, nonemergency by the St. Louis District because of deterioration of the concrete and erosion and vegetation on the embankment, and because the spillway will not pass 50 percent of the PMF.

Complete evaluation of the structure with respect to the visible structural deficiencies is not possible without further investigations.

SUBMITTED BY: SIGNED
Chief, Engineering Division — 14 MAY 1980 — Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer — 14 MAY 1980 — Date

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

NAME OF DAM	Valley Water Mills Dam
STATE LOCATED	Missouri
COUNTY LOCATED	Greene
STREAM	Unnamed tributary to South Dry Sac Creek
DATE OF INSPECTION	June 6 and 7, 1979

Valley Water Mills Dam was inspected using the "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed by the Chief of Engineers, U.S. Army, Washington, D.C., with the help of federal and state agencies, professional engineering organizations and private engineers. The resulting guidelines are considered to represent a consensus of the engineering profession.

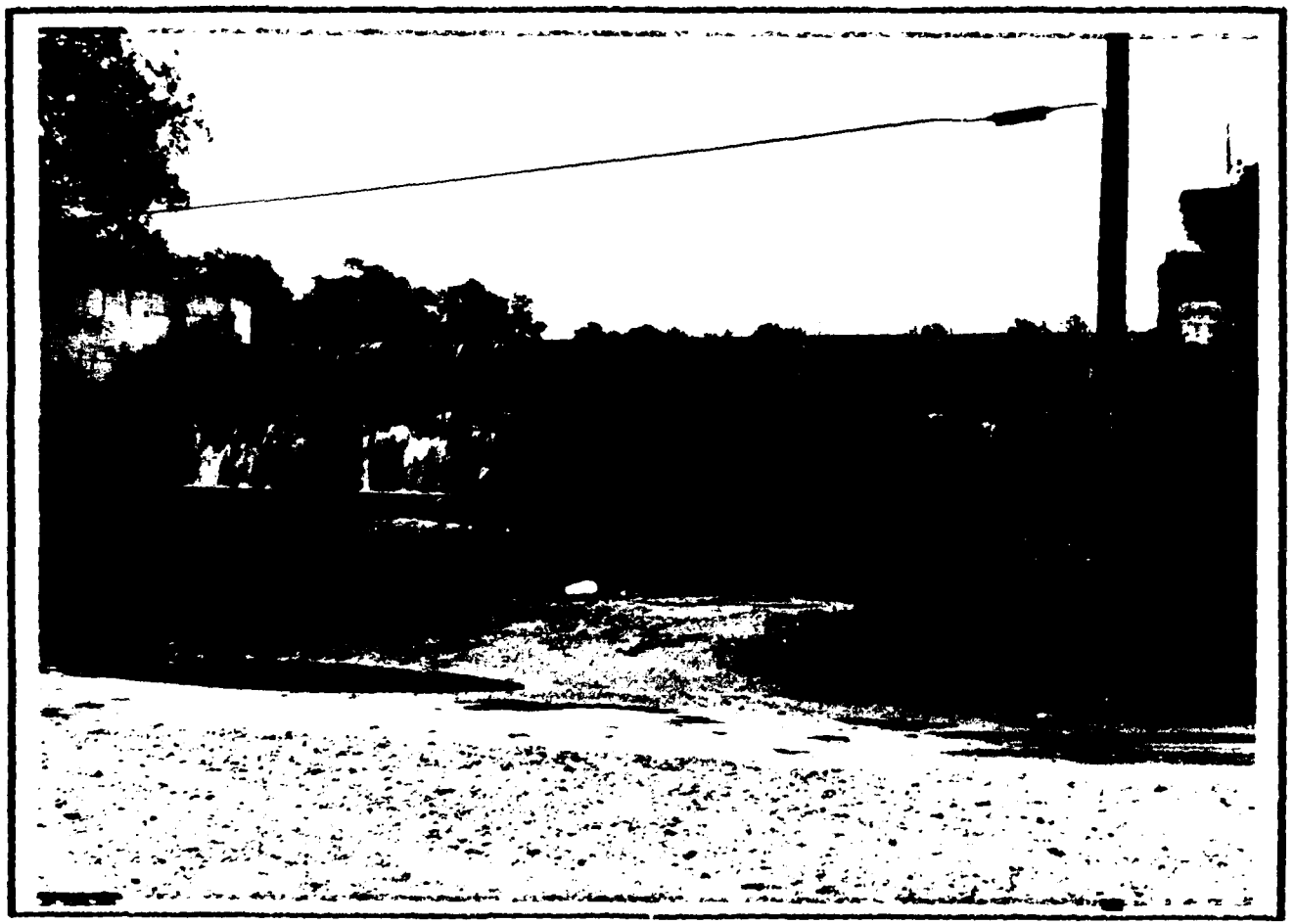
Based on the criteria in the guidelines, the dam is in the high hazard potential classification, which means that loss of life and appreciable property damage could occur in the event of failure of the dam. The dam is in the small size classification since the storage is greater than 50 acre-feet but less than 1000 acre-feet. Because of the downstream exposure, the Spillway Design Flood is the PMF. The PMF is the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. According to the St. Louis District, the estimated length of the damage zone extends approximately one and on-half miles downstream. Within the damage zone are two roads, two dwellings and several buildings. The dam is capable of controlling approximately 7% of the PMF without overtopping the earth embankment. In addition, the dam is not capable of passing the 100 year storm.

Deficiencies visually observed were erosion on the downstream slope of the earth embankment; trees growing on both the upstream and downstream slopes of the earth embankment; deteriorated concrete on the spillway wingwalls, spillway crest and concrete apron; and possible inoperability of the drain valves. These deficiencies should be remedied or monitored at the direction of a professional engineer knowledgeable in dam design to avoid creating an unsafe condition. In addition, the lack of stability, stress and seepage analyses and a warning system are deficiencies according to the "Recommended Guidelines for Safety Inspection of Dams" which should be corrected.

It is recommended that the owner take immediate action to correct or control the deficiencies described.

R. JEFFREY KIMBALL, P.E.
L. Robert Kimball & Associates
Vice President, Earth Sciences

JAMES T. HOCKENSMITH
L. Robert Kimball & Associates
Geologist



Valley Water Mills Dam Spillway - Overview

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
VALLEY WATER MILLS DAM - ID NO. 20035

PART I

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of the Valley Water Mills Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based on available data and visual inspection, in order to determine if the dam poses a hazard to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam was furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) Valley Water Mills is an earthfill dam with a concrete gravity spillway section. This concrete gravity spillway section is located in the middle of the structure with an embankment on either end. The embankments have a total length of approximately 438 feet and a maximum height of approximately 21 feet. The crest width is approximately 15 feet. The upstream slope is approximately 2H:1V and the downstream slope is 3H:1V. The upstream slope contains numerous small trees. The downstream slope has trees, grass and unvegetated areas. The embankment material appears to be a clayey gravel.

The concrete gravity spillway section is 105 feet long and approximately 18 feet high. At each end of the spillway section are concrete wingwalls. The original spillway section of the dam was constructed of a masonry material. This masonry dam was approximately 13 feet high. Based on the configuration of the structure it is obvious that at some unknown date, 5 feet was added to the spillway section. This 5 foot addition was constructed using reinforced concrete. At the same time, four

concrete buttresses were added downstream of the original wall. Immediately downstream of the spillway is a concrete stilling basin. This stilling basin is formed by a 3 foot high concrete sill. Immediately downstream of this concrete sill and stilling basin is a 30 foot long concrete apron.

The outlet works consist of two 30" cast iron pipes through the earth embankment and left spillway retaining wall. The outlet works are controlled by two 16" valves in a valve house on top of the embankment crest adjacent to the spillway. The pipes discharge immediately below the stilling basin. Immediately downstream of the dam is a county road. Flow over the dam passes under this road through a culvert.

b. Location. Valley Water Mills Dam is located approximately 1.7 miles northwest of the interchange of Interstate 44 and U.S. Route 65 near Springfield, Greene County, Missouri on an unnamed tributary of the South Dry Sac Creek. The dam can be located (Section 5, Township 29 North, Range 21 West) on the Bassville, Missouri 7.5 minute U.S.G.S. quadrangle.

c. Size Classification. Valley Water Mills Dam is a small size dam (21 feet high, 128 acre-feet).

d. Hazard Classification. Valley Water Mills Dam is a high hazard dam. Downstream conditions indicate that loss of life is probable should failure of the structure occur. According to the St. Louis District, the estimated length of the damage zone extends approximately one and one-half miles downstream. Within the damage zone are two roads, two dwellings and several buildings.

e. Ownership. Valley Water Mills Dam is owned by the City Utilities of the City of Springfield, Missouri. Correspondence should be addressed to:

Mr. David Plank
Springfield City Utilities
301 East Central Street
Jewell P.O. Box 551
Springfield, MO 65801
417-831-8520

f. Purpose of Dam. Valley Water Mills Dam is used for water supply.

g. Design and Construction History. No design or construction history was available for review. No design drawings, reports or construction history exist.

h. Normal Operating Procedures. No operating records exist. The reservoir is maintained at the spillway crest with the excess inflow discharging over the spillway. Water is drawn off the reservoir on an as-needed basis by opening the drainlines and drawing down the reservoir. The water flows down the unnamed tributary to a subterranean passageway below the dam. The normal flow travels underground to Fulbright Spring which is located near the Fulbright Treatment Plant. At this point, water enters the city's water system. The reservoir is spring fed, but

receives runoff from a drainage area of 5 square miles.

1.3 PERTINENT DATA

a. Drainage Area. 5.0 square miles

b. Discharge at Dam Site (cfs).

(1)	Maximum known flood at dam site	Unknown
(2)	Spillway capacity	2014
(3)	Drainlines	Unknown

c. Elevation (feet) - Based on contour interpolation of spillway crest (1200.0) from the U.S.G.S. quadrangle.

(1)	Top of dam (low point on embankment)	1203.3
(2)	Spillway crest	1200.0
(3)	Normal pool	1200.0
(4)	Maximum pool (PMF)	1210.2
(5)	Entrance invert on 30" cast iron pipes	Unknown
(6)	Exit invert on 30" cast iron pipe	1181.6
(7)	Tailwater on day of inspection (in stilling basin)	1185.1
(8)	Streambed at centerline of dam	1182.0

d. Reservoir (feet).

(1)	Length of maximum pool	2800 feet
(2)	Length of normal pool	1000 feet

e. Storage (acre-feet).

(1)	Top of dam	194
(2)	Spillway crest	138
(3)	Normal pool	138
(4)	Maximum pool (PMF)	324

f. Reservoir Surface (acres).

(1)	Top of dam	18
(2)	Spillway crest	17
(3)	Normal pool	17
(4)	Maximum pool (PMF)	20

g. Dam.

(1)	Type	Earthfill with concrete gravity buttress spillway section
(2)	Length (embankment)	438 feet
(3)	Height	21 feet
(4)	Top width	Approximately 15 feet
(5)	Side Slopes - upstream	2H:1V
	- downstream	3H:1V
(6)	Zoning	None

(7)	Grout Curtain	None

h. Spillway.

(1)	Type	Uncontrolled concrete gravity buttress
(2)	Length	105 feet
(3)	Crest elevation	1200.0
(4)	Upstream channel	Lake
(5)	Downstream channel	Stilling basin and concrete apron
(6)	Weir shape	Broad crested weir

i. Drawdown Facilities.

(1)	Type	30" cast iron pipes with 16" valves
(2)	Elevation - entrance invert	Unknown
	- exit invert	1181.6
(3)	Length	Approximately 45 feet
(4)	Regulation	In valve house at top of embankment

SECTION 2 - ENGINEERING DATA

2.1 DESIGN. No design drawings, reports or data are known to exist.

2.2 CONSTRUCTION. The date of the construction of the dam is unknown. No information is available on the original construction or post-construction changes to the dam.

2.3 OPERATION. No operating records exist.

2.4 EVALUATION.

a. Availability. No engineering data is available.

b. Adequacy. The field surveys and visual inspections presented herein are considered adequate to support the conclusion of this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record. This is a deficiency which should be rectified.

c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. The onsite inspection of Valley Water Mills Dam was conducted by personnel of L. Robert Kimball and Associates accompanied by the owner's engineering staff on June 6 and 7, 1979. The inspection team consisted of a hydrologist, structural/soils engineer and a geologist. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments and toe.
2. Examination of the spillway facilities, exposed portions of any outlet works, and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.

b. Project Geology. The bedrock underlying Valley Water Mills Dam consists of the Mississpian aged Burlington-Keokuk limestone formation which is part of the Osagean Series. This unit may be over 200 feet thick in some areas, but is much thinner in this vicinity.

This formation is a coarsely crystalline, crinoidal limestone which is white to gray in color. Where the beds are dolomitic the color is buff to brown. These beds are rare, however. The formation varies from thin bedded to massive, but is usually medium bedded and weathers to even beds.

Gray to white cherts are often contained within the formation in the form of nodules or beds. The chert weathers to white or brown boulders which become tripolitic and reddish brown upon extreme weathering. The cherty section of the formation is probably in the higher part of the formation and appears to have been eroded from many areas.

Water moving through the limestone has dissolved it in many places, forming a highly uneven bedrock surface, enlarged joints and bedding planes, and caverns. Irregularly shaped pinnacles, some of which may be 10 or 15 feet high, are also common in many areas. These features lie between major "paths" of lateral water movement through residual material toward enlarged joints or bedding planes.

The structural features of this area include faulting to the south and east. There is an extensive upthrust horst block about 400 feet wide and several miles long extending through the southern portion of the lake. The vertical displacement of this feature is over 150 feet. The regional dip of the strata is about 1/2 degree to the southwest.

c. Dam and Spillway. Visual inspection of the dam indicated the structure was in poor condition. From a brief survey conducted during the inspection it was determined that a low portion is present on the right embankment crest. This low point has an elevation of 1203.3. The upstream slope contains numerous small trees and high grass. The downstream slope contains several trees and is grassed. In addition, the downstream slope contains several areas that do not have any vegetation and paths have been developed due to pedestrian travel and erosion of the embankment has begun. The embankment consists of a clayey gravel material.

The concrete section was originally 5 feet lower and was constructed of a stone masonry material. A 5 foot reinforced concrete section was added at a later date. In addition, concrete buttresses were added. The concrete gravity section and buttresses have been gunited. The gunite appears to be in good condition. Close examination of the spillway section was impossible because of the tailwater and water flowing over the weir. There are some deteriorated areas and exposed reinforcing near the crest of the spillway. The concrete wingwalls adjacent to the spillway show significant deterioration of the concrete. The concrete apron below the stilling basin is in a state of disrepair. The concrete is cracked and large holes have developed in the concrete. Some of the water discharging from the stilling basin is flowing into these holes in the concrete. Erosion of soil underneath the concrete appears to be taking place. No quantitative measurements could be made of the cracks due to their inaccessability and inundation.

d. Outlet Works and Drain Lines. The outlet works consist of two 30" cast iron pipes with 16" valves operated from a valve house located on the top of the embankment. The valves appear to be in very poor condition and are not lubricated. The valve house is in a state of disrepair. No doors are located on the valve house to keep unauthorized persons from entering the valve house and possibly opening the valves. It is reported by the owners that the valves were last operated, for the purpose of feeding water to the supply distribution system, in 1954.

e. Reservoir Area. No pertinent problems were noted in the reservoir area. The watershed slopes are moderate with woodland and farmland.

f. Downstream Channel. Discharges from the spillway enter the unnamed tributary of the South Dry Sac Creek for a short distance. The flow then enters a subterranean passage to Fulbright Spring.

3.2 EVALUATION. Visual inspection revealed that the dam, spillway and outlet works are in very poor condition. The presence of the trees and erosion on the embankment slopes, deterioration of the concrete wingwalls, spillway crest, concrete apron and possible inoperability of the drain valves indicate that much needed repairs should be performed. In addition, examination of the upstream face and the stilling basin area were impossible because of the water levels.

Complete evaluation of the structure cannot be made without a detailed stability, seepage or stress analysis with test results of concrete and embankment materials.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES. The reservoir is maintained at the spillway crest at all times. Water is drawn off the reservoir on an as-needed basis. However, the drain lines have not been operated since 1954.

4.2 MAINTENANCE OF THE DAM. No major maintenance of the dam has been conducted for some time. Maintenance of the dam is considered poor.

4.3 MAINTENANCE OF OPERATING FACILITIES. It is reported by the owners that the valves were repaired in 1970. However, the valves have not been operated, for the purpose of feeding water to the supply distribution system, since 1954. In addition, no lubrication has been performed. Maintenance of the operating facilities is considered poor.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT. There is no warning system in effect.

4.5 EVALUATION. Maintenance of the dam and operating facilities is considered poor. There is no warning system in effect to warn downstream residences of large spillway discharges or failure of the dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. There is no hydraulic or hydrologic design data available.

b. Experience Data. The drainage area was developed using the U.S.G.S. quadrangle sheet. The lake surface area was determined by planimetering the quadrangle sheet. Surface area - elevations were determined by planimetering various contour lines within the drainage area on the U.S.G.S. quadrangle sheets. The spillway and dam layout were made from surveys conducted during the inspection. According to the owners, the dam has never been overtopped.

c. Visual Observations. Because of the unvegetated areas on portions of the embankment slopes and the erosion which has taken place, the dam would not be able to control an overtopping for a moderate period of time. Failure of the dam would occur.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway. The PMF is the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

The Corps of Engineers, St. Louis District, has directed that the HEC-1 Dam Safety Version systemized computer program be utilized. The program was prepared by the Hydraulic Engineering Center (HEC) U.S. Army Corps of Engineers, Davis, California, July, 1978. The major methodologies or key input data for this program are discussed in Appendix B.

To enable us to complete the hydraulic and hydrologic analysis for this structure, it was necessary to make the following assumptions:

(1) Water level prior to flood was at the spillway crest (elevation 1200.0).

(2) The top of dam was considered to be the low point (elevation 1203.3).

(3) No flow through the drain lines was considered.

Complete summary sheets of the computer output are presented in Appendix B. To facilitate review, the major results of the overtopping analysis are presented below:

Peak Inflow	29,104 cfs
Spillway Capacity	2,014 cfs

Ratio of PMF	Maximum Reservoir Water Surface Elevation	Maximum Depth over Dam, ft.	Maximum Outflow, cfs	Duration Over Top, Hours
.10	1203.96	.66	2785	1.17
.30	1206.30	3.00	8666	5.50
.50	1207.61	4.31	14434	6.50
.70	1208.70	5.40	20197	7.00
1.00	1210.15	6.85	28888	12.00

The Corps of Engineers Spillway Design Flood for a high hazard-small dam is 1/2 PMF to the PMF. Based on the downstream exposure, the spillway design flood for this dam is the PMF. The spillway is capable of controlling only approximately 7% of the PMF without overtopping the earth embankment. Because of the spillway's inability to control a significant portion of the PMF, the 10-year storm was routed through the reservoir. It was determined that the dam would not be overtopped during the 10-year storm. However, the dam would be overtopped by a 100-year storm.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations did not reveal any immediate signs of instability. No slumps or slides were noted on the embankments. Erosion has begun on the downstream slope and should be repaired and vegetated in the very near future. No misalignment, deflection or cracking of the concrete spillway structure was noted. However, close examination of the concrete structure was impossible because of water discharging over the spillway crest.

b. Design and Construction Data. No design or construction data is available on the dam. The dimensions of the dam cross section are unknown. No testing of the concrete or embankment materials are known to exist. Structural, seepage or stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were available, which is considered a deficiency.

c. Operating Records. No operating records are kept on the structure.

d. Post Construction Changes. The dam was raised approximately 5 feet and buttresses added at an unknown date. The concrete gravity spillway section and buttresses were gunited in 1966. No details or drawings are available on any changes or the original construction.

e. Seismic Stability. The dam is located in seismic zone 2, to which the guidelines assess a "moderate" damage potential. No seismic structural analysis has been constructed. Since the dam is located on several faults, it is felt that a seismic analysis should be investigated.

SECTION 7 - ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. The visual observations, review of available data, hydrologic calculations and past operational performance indicate that Valley Water Mills Dam's spillway is seriously inadequate. The spillway is capable of controlling the 10-year storm, but not the 100-year storm. The spillway is capable of controlling only approximately 7% of the PMF. Based on the condition of the earth embankment section, the structure would not be able to withstand overtopping for a significant period of time.

The dam appeared to be in rather poor condition and poorly maintained. The trees on the embankment slopes should be removed and erosion on the embankments repaired and corrected. The deterioration of the concrete in the spillway crest, retaining walls and concrete apron should be repaired.

No design reports are available on the dam. Seepage, stability and structural analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

It must be noted that dams deteriorate and change with time. Safety reviews for this structure should be made on an on-going basis. Periodic inspections should be conducted of the dam.

b. Adequacy of Information. Complete assessment of the structural stability of the structure cannot be made because of the limited design data, construction data and no past stability, stress, or seepage analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams", which is considered a deficiency.

c. Urgency. The deficiencies described herein are serious and corrective actions listed below should be initiated immediately.

d. Need for Phase II. In order to accomplish some of the recommendations/remedial measures outlined below, further investigations will be required, however, a Phase II investigation is not required.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

a. A registered professional engineer knowledgeable in concrete and earthfill dam design should be retained to perform a detailed hydrologic analysis to increase spillway capacity. Spillway capacity should be increased and an in investigation should be made of the requirements of the energy dissipating structure.

b. A stability (including seismic), stress and seepage analysis should be conducted by a registered professional engineer knowledgeable in concrete and earthfill dams.

c. The erosion on the earth embankments should be repaired and seeded.

d. The deteriorated concrete on the wingwalls, crest of the spillway and spillway apron should be repaired.

e. The drain valves should be operated and lubricated on a regularly scheduled basis.

f. Institute a formal warning system to warn downstream residences of high spillway discharges or failure of the dam.

g. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of concrete and earthfill dams.

APPENDIX A

DRAWINGS

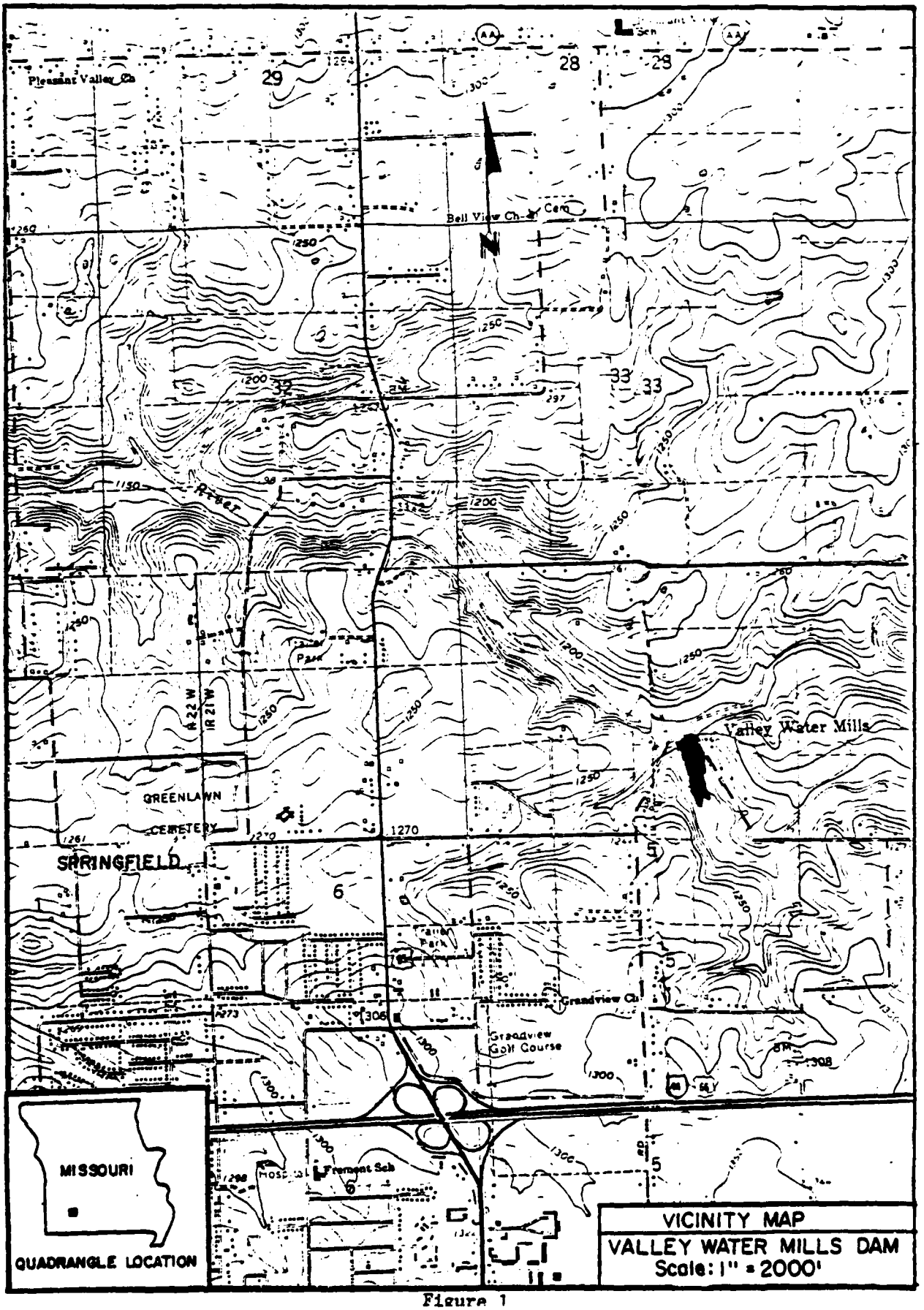

Pleasant Valley Ch
Bell View Ch & Cem
Valley Water Mills
GREENLAWN CEMETERY
SPRINGFIELD
Grandview Ch
Grandview Golf Course
Fremont Sch
MISSOURI
QUADRANGLE LOCATION
VICINITY MAP
VALLEY WATER MILLS DAM
Scale: 1" = 2000'

Figure 1

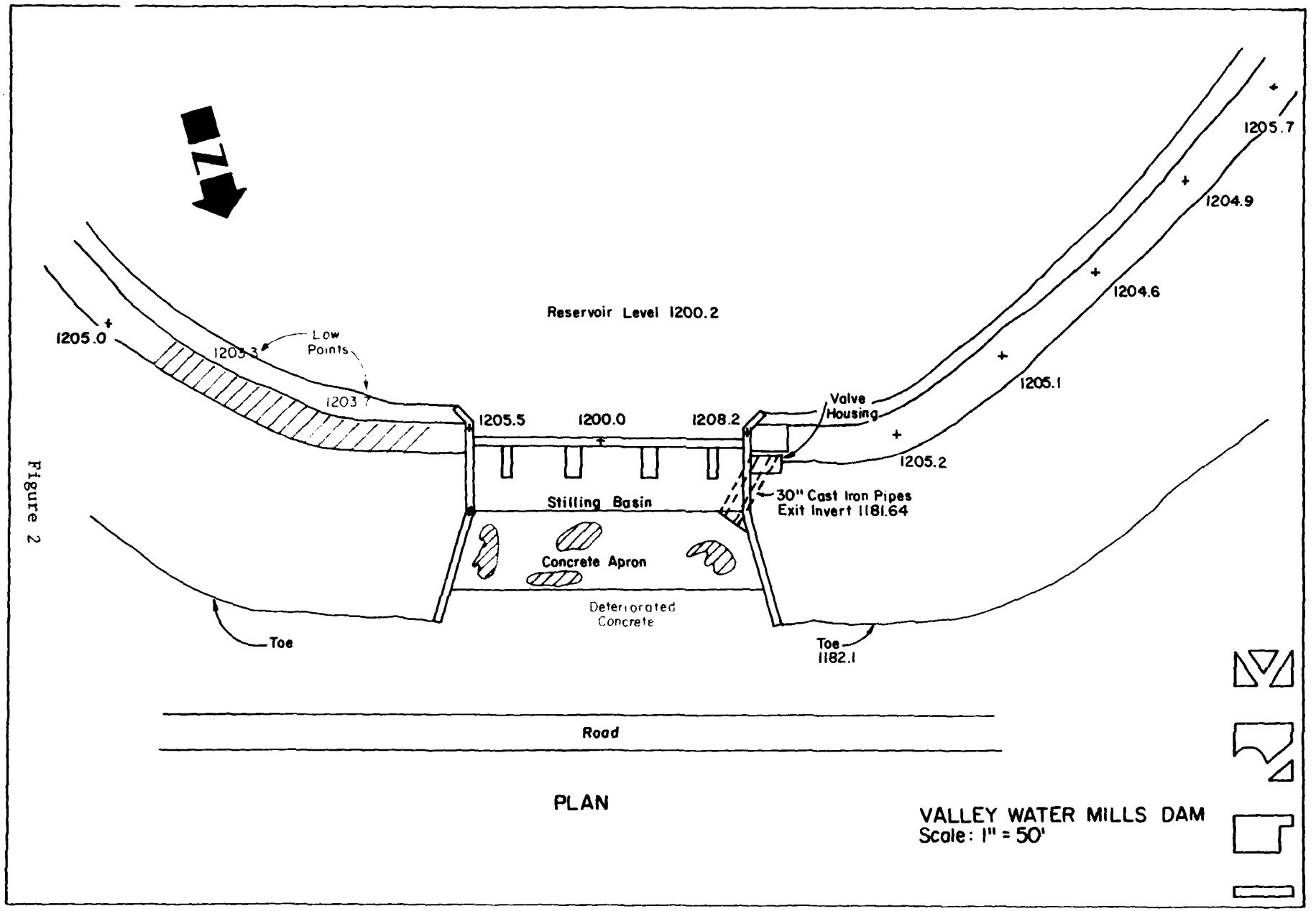

Reservoir Level 1200.2
1205.0
1203.3
Low Points
1203.7
1205.5
1200.0
1208.2
Valve Housing
1205.7
1204.9
1204.6
1205.1
1205.2
Stilling Basin
30" Cast Iron Pipes
Exit Invert 1181.64
Concrete Apron
Deteriorated Concrete
Toe
Toe
1182.1
Road
PLAN
VALLEY WATER MILLS DAM
Scale: 1" = 50'

Figure 2

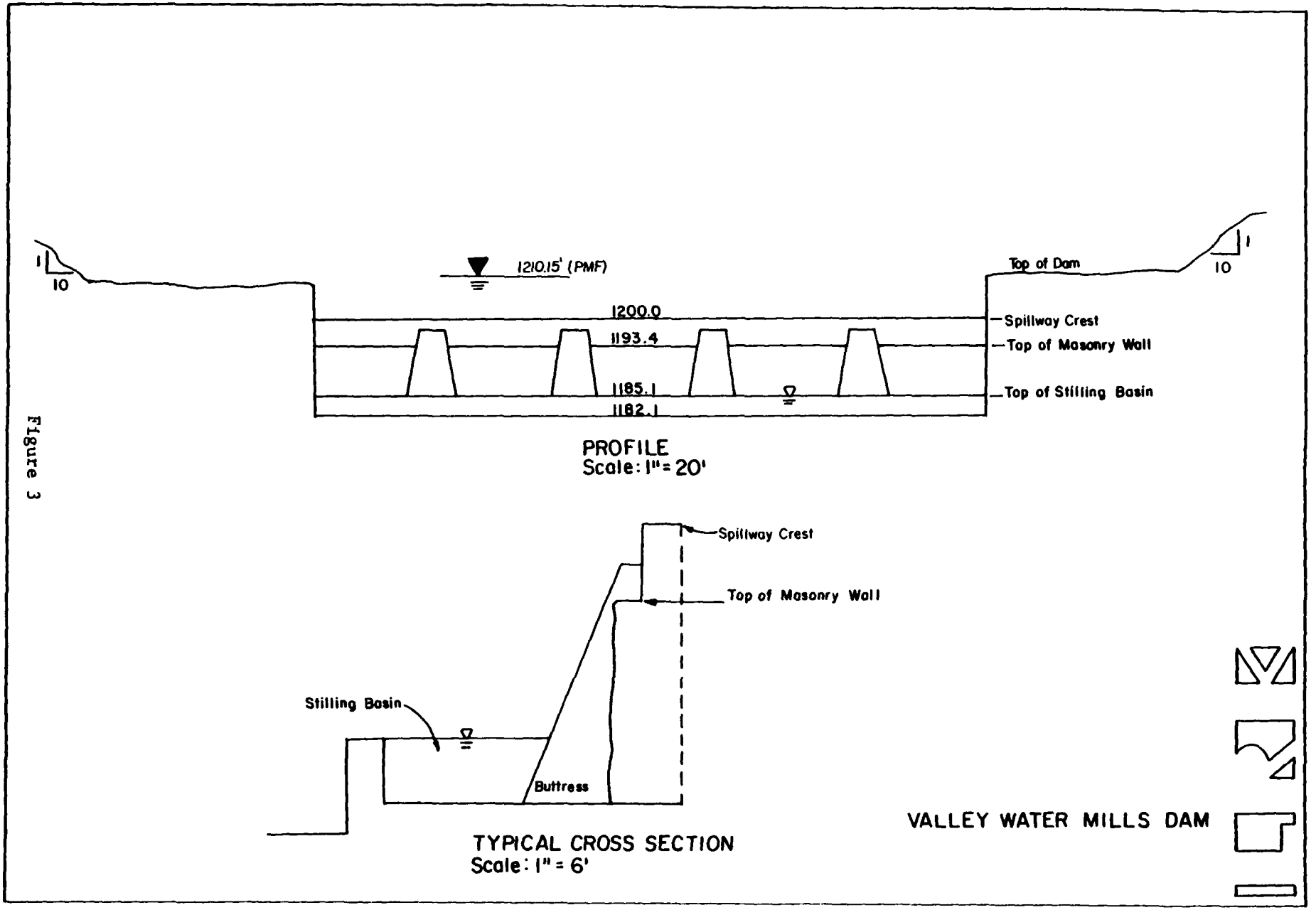

1
10
1210.15' (PMF)
Top of Dam
1
10
1200.0
1193.4
1185.1
1182.1
Spillway Crest
Top of Masonry Wall
Top of Stilling Basin
PROFILE
Scale: 1" = 20'
Spillway Crest
Top of Masonry Wall
Stilling Basin
Buttress
TYPICAL CROSS SECTION
Scale: 1" = 6'
VALLEY WATER MILLS DAM

Figure 3

APPENDIX B

HYDROLOGY AND HYDRAULICS

APPENDIX B

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for a reservoir routing. The Probable Maximum Precipitation is derived and determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33." Reduction factors have not been applied. A 48 hour storm duration is assumed with total depth distributed over 6 hour periods in accordance with procedures outlined in EM 1110-2-1411 (SPF Determination). The maximum 6 hour rainfall period is then distributed to hourly increments by the same criteria. Within-the-hour distribution is based upon NOAA Technical Memorandum NWS HYDRO-35. The non-peak 6 hour rainfall periods are distributed uniformly. All distributed values are arranged in a critical sequence by the SPF criteria. The final inflow hydrograph is produced by deduction of infiltration losses appropriate to the soil, land use, and antecedent moisture conditions.

The reservoir routing is accomplished by using Modified Puls routing techniques wherein the flood hydrograph is routed through lake storage. Hydraulic capacities of the outlet works, spillways, and crest of dam are used as outlet controls in the routing. Storage in the pool area is defined by an elevation-storage capacity curve. The hydraulic capacity of the outlet works, spillways, and top of dam are defined by elevation-discharge curves.

Dam overtopping analysis has been conducted by hydrologic methods for this dam and lake. This computation determines the percentage of the PMF hydrograph that the reservoir can contain without the dam being overtopped. An output summary in the hydrologic appendix displays this information as well as other characteristics of the simulated dam overtopping.

The above analysis has been accomplished for this report using the systemized computer program HEC-1 (Dam Safety Version), July, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. The numeric parameters estimated for this site are listed in the computer printout. Definitions of these variables are contained in the "User's Manual" for the computer program.

The inflow hydrograph was routed through the reservoir using HEC-1's Modified Puls option.

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME VALLEY WATER MILLS
I.D. NUMBER 20035
SHEET NO. 1 OF 2
BY OTM DATE 7-18-79

VALLEY WATER MILLS DAM

DRAINAGE AREA

AREA = 5 mi^2 (ST. LOUIS DISTRICT C.O.E.)

UNIT HYDROGRAPH PARAMETERS

KIRPICH METHOD:

t_R = 1.28 HRS. LAG (L) = 0.6 t_R = 0.8 HRS.
WHERE LENGTH (L) = 17,000 FT.
HEIGHT (H) = 200 FT.
(FROM, TIME OF CONCENTRATION NOMOGRAPH, KENTUCKY BUREAU OF HIGHWAYS)

CURVE NUMBER METHOD:

$$\text{LAG (L)} = \frac{l^{0.8}(S+1)^{0.7}}{1900\ Y^{0.5}} = \frac{(17{,}000)^{0.8}(2.90)^{0.7}}{1900\ (3.0)^{0.5}}$$

$$= \frac{(2423)(2.11)}{3291} = 1.6 \text{ HRS}$$

WHERE l = GREATEST FLOW LENGTH IN FEET

$S = \frac{1000}{CN} - 10$ AND CN = CURVE NUMBER
Y = AVERAGE SLOPE (%)

LOSS RATE AND BASE FLOW PARAMETERS

STRTL = 1 INCH
CNSTL = 84 * SCS CURVE NUMBER
STRTQ = 1.5 CFS/mi^2
QRCSN = 0.05 (5% OF PEAK FLOW)
RTIOR = 2.5

* UTILIZED ANTECEDENT MOISTURE CONDITION III

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME VALLEY WATER MILLS
I.D. NUMBER 20035
SHEET NO. 2 OF 2
BY O.T.M. DATE 7-18-79

PROBABLE MAXIMUM STORM

FROM H.R. No. 33

PMP INDEX RAINFALL (ZONE 7) = 26.5 INCHES
R_6 = 102 %, R_{12} = 120 %, R_{24} = 130 %, R_{48} = 140 %

ELEVATION-AREA-CAPACITY-RELATIONSHIP

SPILLWAY CREST ELEV. = 1200', AREA = 17 ACRES
INITAL STORAGE = 138 AC·FT

ELEV. 1220, AREA = 25 ACRES
ELEV. 1240, AREA = 48 ACRES
ELEV. 1260, AREA = 79 ACRES
ELEV. 1280, AREA = 119 ACRES
} FROM U.S.G.S. 7.5 MIN. QUAD.

FROM CONIC METHOD FOR RESERVOIR VOLUME. FLOOD HYDROGRAPH PACKAGE (HEC-1). DAM SAFETY VERSION (USERS MANUAL).

$H = 3V/A = 3(138)/17 \approx 24$ FT.

ELEV. WHERE CAPACITY EQUALS ZERO;
1200 - 24 = 1176 FT.

AREA (Ac)	0	17	20	25	40	48	60	79	119
ELEV. (FT.)	1176	1200	1210	1220	1235	1240	1250	1260	1280

DISCHARGE PRAMETERS

	WEIR LENGTH	COEFFICIENT (C)
SPILLWAY	105'	3.2 (FLAT, CONCRETE)
DAM (OVERTOP)	438'	3.0 (BROAD CREST)

FROM: $Q = CLH^{3/2}$

```
*************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
 LAST MODIFICATION  26 FEB 79
*************************************
  1       A1      ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
  2       A2      HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF VALLEY WATER MILLS DAM
  3       A3      RATIOS OF PMF ROUTED THROUGH THE RESERVOIR  (MISSOURI-20035)
  4       B     288       0      10       0       0       0       0       0       0       0
  5       B1      5
  6       J       1       5       1
  7       J1     .1      .3      .5      .7       1
  8       K       0       1                                       1
  9       K1      INFLOW TO RESERVOIR
 10       M       1       2       5               5       1                       1
 11       P            26.5     102     120     130     140
 12       T                                                      -1     -84
 13       W2            0.8
 14       X    -1.5    -.05     2.5
 15       K       1       2                                       1
 16       K1      ROUTE THROUGH RESERVOIR
 17       Y                               1       1
 18       Y1      1                                           -1200
 19       $A      0      17      20      25      40      48      60      79     100     119
 20       $E   1176    1200    1210    1220    1235    1240    1250    1260    1270    1280
 21       $$   1200     105     3.2     1.5
 22       $D1203.3      3.0     1.5     438
 23       $L     50     105     123     173     223     278     328     417     436     438
 24       $V1203.3 1203.7    1204  1204.6  1204.9    1205  1205.1  1205.5  1205.7  1208.2
 25       K      99
```

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

RUN DATE 79/07/11.
TIME 12.47.20.

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF VALLEY WATER MILLS DAM
RATIOS OF PMF ROUTED THROUGH THE RESERVOIR (MISSOURI-200351)

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

B-5

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1

RTIOS= .10 .30 .50 .70 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	5.00	0.00	5.00	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	26.50	102.00	120.00	130.00	140.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-84.00	0.00	0.00

CURVE NO = -84.00 WETNESS = -1.00 EFFECT CN = 84.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .80

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.50

UNIT HYDROGRAPH 26 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .80 VOL= 1.00

252.	774.	1629.	2407.	2720.	2655.	2307.	1829.	1263.	924.	
690.	514.	373.	276.	202.	147.	108.	80.	59.	43.	
32.	25.	19.	13.	8.	3.					

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.10	1	.00	0.00	.00	7.	1.02	.10	145	.03	.02	.01	57.
1.01	.20	2	.00	0.00	.00	6.	1.02	.20	146	.03	.02	.01	73.
1.01	.30	3	.00	0.00	.00	6.	1.02	.30	147	.03	.02	.01	107.
1.01	.40	4	.00	0.00	.00	5.	1.02	.40	148	.03	.02	.01	157.
1.01	.50	5	.00	0.00	.00	5.	1.02	.50	149	.03	.02	.01	214.
1.01	1.00	6	.00	0.00	.00	4.	1.02	1.00	150	.03	.02	.01	269.
1.01	1.10	7	.00	0.00	.00	4.	1.02	1.10	151	.03	.02	.01	318.
1.01	1.20	8	.00	0.00	.00	4.	1.02	1.20	152	.03	.02	.01	356.
1.01	1.30	9	.00	0.00	.00	3.	1.02	1.30	153	.03	.02	.01	384.

1.01	1.40	10	.00	0.00	.00	3.	1.02	1.40	154	.03	.02	.01	404.
1.01	1.50	11	.00	0.00	.00	3.	1.02	1.50	155	.03	.02	.01	420.
1.01	2.00	12	.00	0.00	.00	2.	1.02	2.00	156	.03	.02	.01	432.
1.01	2.10	13	.00	0.00	.00	2.	1.02	2.10	157	.03	.02	.01	441.
1.01	2.20	14	.00	0.00	.00	2.	1.02	2.20	158	.03	.02	.01	448.
1.01	2.30	15	.00	0.00	.00	2.	1.02	2.30	159	.03	.02	.01	453.
1.01	2.40	16	.00	0.00	.00	2.	1.02	2.40	160	.03	.02	.00	458.
1.01	2.50	17	.00	0.00	.00	2.	1.02	2.50	161	.03	.02	.00	461.
1.01	3.00	18	.00	0.00	.00	1.	1.02	3.00	162	.03	.02	.00	464.
1.01	3.10	19	.00	0.00	.00	1.	1.02	3.10	163	.03	.02	.00	467.
1.01	3.20	20	.00	0.00	.00	1.	1.02	3.20	164	.03	.02	.00	469.
1.01	3.30	21	.00	0.00	.00	1.	1.02	3.30	165	.03	.02	.00	471.
1.01	3.40	22	.00	0.00	.00	1.	1.02	3.40	166	.03	.02	.00	472.
1.01	3.50	23	.00	0.00	.00	1.	1.02	3.50	167	.03	.02	.00	474.
1.01	4.00	24	.00	0.00	.00	1.	1.02	4.00	168	.03	.02	.00	476.
1.01	4.10	25	.00	0.00	.00	1.	1.02	4.10	169	.03	.02	.00	477.
1.01	4.20	26	.00	0.00	.00	1.	1.02	4.20	170	.03	.03	.00	478.
1.01	4.30	27	.00	0.00	.00	1.	1.02	4.30	171	.03	.03	.00	479.
1.01	4.40	28	.00	0.00	.00	1.	1.02	4.40	172	.03	.03	.00	480.
1.01	4.50	29	.00	0.00	.00	1.	1.02	4.50	173	.03	.03	.00	481.
1.01	5.00	30	.00	0.00	.00	0.	1.02	5.00	174	.03	.03	.00	482.
1.01	5.10	31	.00	0.00	.00	0.	1.02	5.10	175	.03	.03	.00	484.
1.01	5.20	32	.00	0.00	.00	0.	1.02	5.20	176	.03	.03	.00	485.
1.01	5.30	33	.00	0.00	.00	0.	1.02	5.30	177	.03	.03	.00	486.
1.01	5.40	34	.00	0.00	.00	0.	1.02	5.40	178	.03	.03	.00	487.
1.01	5.50	35	.00	0.00	.00	0.	1.02	5.50	179	.03	.03	.00	488.
1.01	6.00	36	.00	0.00	.00	0.	1.02	6.00	180	.03	.03	.00	488.
1.01	6.10	37	.01	0.00	.01	0.	1.02	6.10	181	.13	.12	.02	512.
1.01	6.20	38	.01	0.00	.01	0.	1.02	6.20	182	.13	.12	.02	583.
1.01	6.30	39	.01	0.00	.01	0.	1.02	6.30	183	.13	.12	.02	731.
1.01	6.40	40	.01	0.00	.01	0.	1.02	6.40	184	.13	.12	.01	950.
1.01	6.50	41	.01	0.00	.01	0.	1.02	6.50	185	.13	.12	.01	1199.
1.01	7.00	42	.01	0.00	.01	0.	1.02	7.00	186	.13	.12	.01	1444.
1.01	7.10	43	.01	0.00	.01	0.	1.02	7.10	187	.13	.12	.01	1659.
1.01	7.20	44	.01	0.00	.01	0.	1.02	7.20	188	.13	.12	.01	1833.
1.01	7.30	45	.01	0.00	.01	0.	1.02	7.30	189	.13	.12	.01	1956.

1.01	7.40	46	.01	0.00	.01	0.	1.02	7.40	190	.13	.12	.01	2050.
1.01	7.50	47	.01	0.00	.01	0.	1.02	7.50	191	.13	.12	.01	2122.
1.01	8.00	48	.01	0.00	.01	0.	1.02	8.00	192	.13	.12	.01	2179.
1.01	8.10	49	.01	0.00	.01	0.	1.02	8.10	193	.13	.12	.01	2222.
1.01	8.20	50	.01	0.00	.01	0.	1.02	8.20	194	.13	.12	.01	2257.
1.01	8.30	51	.01	0.00	.01	0.	1.02	8.30	195	.13	.12	.01	2285.
1.01	8.40	52	.01	0.00	.01	0.	1.02	8.40	196	.13	.12	.01	2307.
1.01	8.50	53	.01	0.00	.01	0.	1.02	8.50	197	.13	.12	.01	2325.
1.01	9.00	54	.01	0.00	.01	0.	1.02	9.00	198	.13	.12	.01	2340.
1.01	9.10	55	.01	0.00	.01	0.	1.02	9.10	199	.13	.12	.01	2353.
1.01	9.20	56	.01	0.00	.01	0.	1.02	9.20	200	.13	.12	.01	2365.
1.01	9.30	57	.01	0.00	.01	0.	1.02	9.30	201	.13	.12	.01	2375.
1.01	9.40	58	.01	0.00	.01	0.	1.02	9.40	202	.13	.13	.01	2383.
1.01	9.50	59	.01	0.00	.01	0.	1.02	9.50	203	.13	.13	.01	2391.
1.01	10.00	60	.01	0.00	.01	0.	1.02	10.00	204	.13	.13	.01	2399.
1.01	10.10	61	.01	0.00	.01	0.	1.02	10.10	205	.13	.13	.01	2405.
1.01	10.20	62	.01	0.00	.01	0.	1.02	10.20	206	.13	.13	.01	2411.
1.01	10.30	63	.01	0.00	.01	0.	1.02	10.30	207	.13	.13	.01	2416.
1.01	10.40	64	.01	0.00	.01	0.	1.02	10.40	208	.13	.13	.01	2421.
1.01	10.50	65	.01	0.00	.01	0.	1.02	10.50	209	.13	.13	.01	2425.
1.01	11.00	66	.01	.00	.01	0.	1.02	11.00	210	.13	.13	.01	2430.
1.01	11.10	67	.01	.00	.01	0.	1.02	11.10	211	.13	.13	.01	2434.
1.01	11.20	68	.01	.00	.01	0.	1.02	11.20	212	.13	.13	.01	2438.
1.01	11.30	69	.01	.00	.01	1.	1.02	11.30	213	.13	.13	.01	2442.
1.01	11.40	70	.01	.00	.01	1.	1.02	11.40	214	.13	.13	.01	2445.
1.01	11.50	71	.01	.00	.01	2.	1.02	11.50	215	.13	.13	.01	2449.
1.01	12.00	72	.01	.00	.01	3.	1.02	12.00	216	.13	.13	.00	2452.
1.01	12.10	73	.03	.00	.03	5.	1.02	12.10	217	.45	.43	.02	2533.
1.01	12.20	74	.03	.00	.03	8.	1.02	12.20	218	.45	.44	.01	2774.
1.01	12.30	75	.03	.00	.03	15.	1.02	12.30	219	.45	.44	.01	3278.
1.01	12.40	76	.03	.01	.03	24.	1.02	12.40	220	.45	.44	.01	4023.
1.01	12.50	77	.03	.01	.03	36.	1.02	12.50	221	.45	.44	.01	4866.
1.01	13.00	78	.03	.01	.03	51.	1.02	13.00	222	.45	.44	.01	5692.
1.01	13.10	79	.04	.01	.03	68.	1.02	13.10	223	.54	.53	.01	6435.
1.01	13.20	80	.04	.01	.03	86.	1.02	13.20	224	.54	.53	.01	7079.
1.01	13.30	81	.04	.01	.03	106.	1.02	13.30	225	.54	.53	.01	7625.

1.01	13.40	82	.04	.01	.03	128.	1.02	13.40	226	.54	.53	.01	8137.
1.01	13.50	83	.04	.01	.03	151.	1.02	13.50	227	.54	.53	.01	8604.
1.01	14.00	84	.04	.02	.03	175.	1.02	14.00	228	.54	.53	.01	9011.
1.01	14.10	85	.05	.02	.03	199.	1.02	14.10	229	.68	.67	.01	9378.
1.01	14.20	86	.05	.02	.03	224.	1.02	14.20	230	.68	.67	.01	9741.
1.01	14.30	87	.05	.02	.03	253.	1.02	14.30	231	.68	.67	.01	10146.
1.01	14.40	88	.05	.02	.03	284.	1.02	14.40	232	.68	.67	.01	10607.
1.01	14.50	89	.05	.03	.03	317.	1.02	14.50	233	.68	.67	.01	11076.
1.01	15.00	90	.05	.03	.03	349.	1.02	15.00	234	.68	.67	.01	11513.
1.01	15.10	91	.05	.02	.02	380.	1.02	15.10	235	.62	.61	.01	11869.
1.01	15.20	92	.08	.04	.04	411.	1.02	15.20	236	1.03	1.02	.01	12219.
1.01	15.30	93	.14	.08	.06	456.	1.02	15.30	237	1.85	1.84	.01	12851.
1.01	15.40	94	.36	.23	.13	569.	1.02	15.40	238	4.62	4.60	.03	14854.
1.01	15.50	95	.10	.07	.03	762.	1.02	15.50	239	1.34	1.33	.01	18434.
1.01	16.00	96	.06	.04	.02	1023.	1.02	16.00	240	.82	.82	.00	23280.
1.01	16.10	97	.05	.03	.01	1255.	1.02	16.10	241	.63	.63	.00	27393.
1.01	16.20	98	.05	.03	.01	1372.	1.02	16.20	242	.63	.63	.00	29104.
1.01	16.30	99	.05	.04	.01	1379.	1.02	16.30	243	.63	.63	.00	28597.
1.01	16.40	100	.05	.04	.01	1300.	1.02	16.40	244	.63	.63	.00	26423.
1.01	16.50	101	.05	.04	.01	1176.	1.02	16.50	245	.63	.63	.00	23448.
1.01	17.00	102	.05	.04	.01	1038.	1.02	17.00	246	.63	.63	.00	20297.
1.01	17.10	103	.04	.03	.01	942.	1.02	17.10	247	.50	.49	.00	18075.
1.01	17.20	104	.04	.03	.01	872.	1.02	17.20	248	.50	.49	.00	16428.
1.01	17.30	105	.04	.03	.01	813.	1.02	17.30	249	.50	.49	.00	15069.
1.01	17.40	106	.04	.03	.01	760.	1.02	17.40	250	.50	.49	.00	13872.
1.01	17.50	107	.04	.03	.01	715.	1.02	17.50	251	.50	.49	.00	12875.
1.01	18.00	108	.04	.03	.01	678.	1.02	18.00	252	.50	.49	.00	12047.
1.01	18.10	109	.00	.00	.00	642.	1.02	18.10	253	.04	.04	.00	11277.
1.01	18.20	110	.00	.00	.00	599.	1.02	18.20	254	.04	.04	.00	10435.
1.01	18.30	111	.00	.00	.00	541.	1.02	18.30	255	.04	.04	.00	9351.
1.01	18.40	112	.00	.00	.00	465.	1.02	18.40	256	.04	.04	.00	8009.
1.01	18.50	113	.00	.00	.00	384.	1.02	18.50	257	.04	.04	.00	6592.
1.01	19.00	114	.00	.00	.00	307.	1.02	19.00	258	.04	.04	.00	5258.
1.01	19.10	115	.00	.00	.00	241.	1.02	19.10	259	.04	.04	.00	4121.
1.01	19.20	116	.00	.00	.00	189.	1.02	19.20	260	.04	.04	.00	3220.
1.01	19.30	117	.00	.00	.00	152.	1.02	19.30	261	.04	.04	.00	2586.

1.01	19.40	118	.00	.00	.00	125.	1.02	19.40	262	.04	.04	.00	2117.
1.01	19.50	119	.00	.00	.00	105.	1.02	19.50	263	.04	.04	.00	1764.
1.01	20.00	120	.00	.00	.00	90.	1.02	20.00	264	.04	.04	.00	1507.
1.01	20.10	121	.00	.00	.00	79.	1.02	20.10	265	.04	.04	.00	1365.
1.01	20.20	122	.00	.00	.00	72.	1.02	20.20	266	.04	.04	.00	1245.
1.01	20.30	123	.00	.00	.00	66.	1.02	20.30	267	.04	.04	.00	1136.
1.01	20.40	124	.00	.00	.00	62.	1.02	20.40	268	.04	.04	.00	1037.
1.01	20.50	125	.00	.00	.00	59.	1.02	20.50	269	.04	.04	.00	982.
1.01	21.00	126	.00	.00	.00	57.	1.02	21.00	270	.04	.04	.00	945.
1.01	21.10	127	.00	.00	.00	55.	1.02	21.10	271	.04	.04	.00	917.
1.01	21.20	128	.00	.00	.00	54.	1.02	21.20	272	.04	.04	.00	897.
1.01	21.30	129	.00	.00	.00	53.	1.02	21.30	273	.04	.04	.00	883.
1.01	21.40	130	.00	.00	.00	53.	1.02	21.40	274	.04	.04	.00	871.
1.01	21.50	131	.00	.00	.00	52.	1.02	21.50	275	.04	.04	.00	863.
1.01	22.00	132	.00	.00	.00	52.	1.02	22.00	276	.04	.04	.00	857.
1.01	22.10	133	.00	.00	.00	52.	1.02	22.10	277	.04	.04	.00	854.
1.01	22.20	134	.00	.00	.00	52.	1.02	22.20	278	.04	.04	.00	852.
1.01	22.30	135	.00	.00	.00	52.	1.02	22.30	279	.04	.04	.00	852.
1.01	22.40	136	.00	.00	.00	52.	1.02	22.40	280	.04	.04	.00	852.
1.01	22.50	137	.00	.00	.00	52.	1.02	22.50	281	.04	.04	.00	852.
1.01	23.00	138	.00	.00	.00	52.	1.02	23.00	282	.04	.04	.00	852.
1.01	23.10	139	.00	.00	.00	52.	1.02	23.10	283	.04	.04	.00	852.
1.01	23.20	140	.00	.00	.00	52.	1.02	23.20	284	.04	.04	.00	852.
1.01	23.30	141	.00	.00	.00	52.	1.02	23.30	285	.04	.04	.00	853.
1.01	23.40	142	.00	.00	.00	52.	1.02	23.40	286	.04	.04	.00	853.
1.01	23.50	143	.00	.00	.00	52.	1.02	23.50	287	.04	.04	.00	853.
1.02	0.00	144	.00	.00	.00	52.	1.03	0.00	288	.04	.04	.00	853.
									SUM	37.10	34.91	2.19	670685.
										942.11	887.11	56.11	18991.68

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	29104.	13823.	4491.	2327.	670255.
CMS	824.	391.	127.	66.	18979.
INCHES		25.72	33.42	34.64	34.64
MM		653.22	848.82	879.82	879.82

323.	325.	327.	328.	330.	331.	332.	333.	334.	335.
335.	336.	337.	338.	338.	339.	340.	341.	341.	342.
358.	408.	511.	665.	839.	1010.	1161.	1283.	1369.	1435.
1486.	1525.	1556.	1580.	1599.	1615.	1628.	1638.	1647.	1655.
1662.	1668.	1674.	1679.	1683.	1687.	1691.	1694.	1698.	1701.
1704.	1706.	1709.	1712.	1714.	1716.	1773.	1941.	2294.	2816.
3406.	3984.	4505.	4955.	5338.	5696.	6023.	6308.	6564.	6819.
7102.	7425.	7754.	8059.	8308.	8553.	8996.	10398.	12904.	16296.
19175.	20373.	20018.	18496.	16413.	14208.	12653.	11499.	10548.	9710.
9013.	8433.	7894.	7305.	6545.	5606.	4615.	3681.	2885.	2254.
1810.	1482.	1235.	1055.	955.	872.	795.	726.	688.	661.
642.	628.	618.	610.	604.	600.	598.	597.	597.	597.
597.	597.	597.	597.	597.	597.	597.	597.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	20373.	9676.	3143.	1629.	469178.
CMS	577.	274.	89.	46.	13286.
INCHES		18.00	23.39	24.25	24.25
MM		457.25	594.17	615.87	615.87
AC-FT		4798.	6235.	6463.	6463.
THOUS CU M		5918.	7691.	7971.	7971.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 5

7.	6.	6.	5.	5.	4.	4.	4.	3.	3.
3.	2.	2.	2.	2.	2.	2.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	1.	1.
2.	3.	5.	8.	15.	24.	36.	51.	68.	86.
106.	128.	151.	175.	199.	224.	253.	284.	317.	349.
380.	411.	456.	569.	762.	1023.	1255.	1372.	1379.	1300.
1176.	1038.	942.	872.	813.	760.	715.	678.	642.	599.

541.	465.	384.	307.	241.	189.	152.	125.	105.	90.
79.	72.	66.	62.	59.	57.	55.	54.	53.	53.
52.	52.	52.	52.	52.	52.	52.	52.	52.	52.
52.	52.	52.	52.	57.	73.	107.	157.	214.	269.
318.	356.	384.	404.	420.	432.	441.	448.	453.	458.
461.	464.	467.	469.	471.	472.	474.	476.	477.	478.
479.	480.	481.	482.	484.	485.	486.	487.	488.	488.
512.	583.	731.	950.	1199.	1444.	1659.	1833.	1956.	2050.
2122.	2179.	2222.	2257.	2285.	2307.	2325.	2340.	2353.	2365.
2375.	2383.	2391.	2399.	2405.	2411.	2416.	2421.	2425.	2430.
2434.	2438.	2442.	2445.	2449.	2452.	2533.	2774.	3278.	4023.
4866.	5692.	6435.	7079.	7625.	8137.	8604.	9011.	9378.	9741.
101466.	10607.	11076.	11513.	11869.	12219.	12851.	14854.	18434.	23280.
27393.	29104.	28597.	26423.	23448.	20297.	18075.	16428.	15069.	13872.
12875.	12047.	11277.	10435.	9351.	8009.	6592.	5258.	4121.	3220.
2586.	2117.	1764.	1507.	1365.	1245.	1136.	1037.	982.	945.
917.	897.	883.	871.	863.	857.	854.	852.	852.	852.
852.	852.	852.	852.	853.	853.	853.	853.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	29104.	13823.	4491.	2327.	670255.
CMS	824.	391.	127.	66.	18979.
INCHES		25.72	33.42	34.64	34.64
MM		653.22	848.82	879.82	879.82
AC-FT		6854.	8907.	9232.	9232.
THOUS CU M		8455.	10986.	11388.	11388.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1200.	0

SURFACE AREA=	0.	17.	20.	25.	40.	48.	60.	79.	100.	119.
CAPACITY=	0.	136.	321.	545.	1028.	1248.	1787.	2480.	3373.	4466.
ELEVATION=	1176.	1200.	1210.	1220.	1235.	1240.	1250.	1260.	1270.	1280.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1200.0	105.0	3.2	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1203.3	3.0	1.5	438.

CREST LENGTH AT OR BELOW ELEVATION	50.	105.	123.	173.	293.	278.	328.	417.	436.	438.
	1203.3	1203.7	1204.0	1204.6	1204.9	1205.0	1205.1	1205.5	1205.7	1208.2

STATION 2, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .30	RATIO 3 .50	RATIO 4 .70	RATIO 5 1.00
HYDROGRAPH AT	1	5.00	1	2910.	8731.	14552.	20373.	29104.
		(12.95)		(82.41)(	247.24)(	412.07)(	576.89)(	824.14)(
ROUTED TO	2	5.00	1	2785.	8666.	14434.	20197.	28888.
		(12.95)		(78.85)(	245.40)(	408.74)(	571.92)(	818.02)(

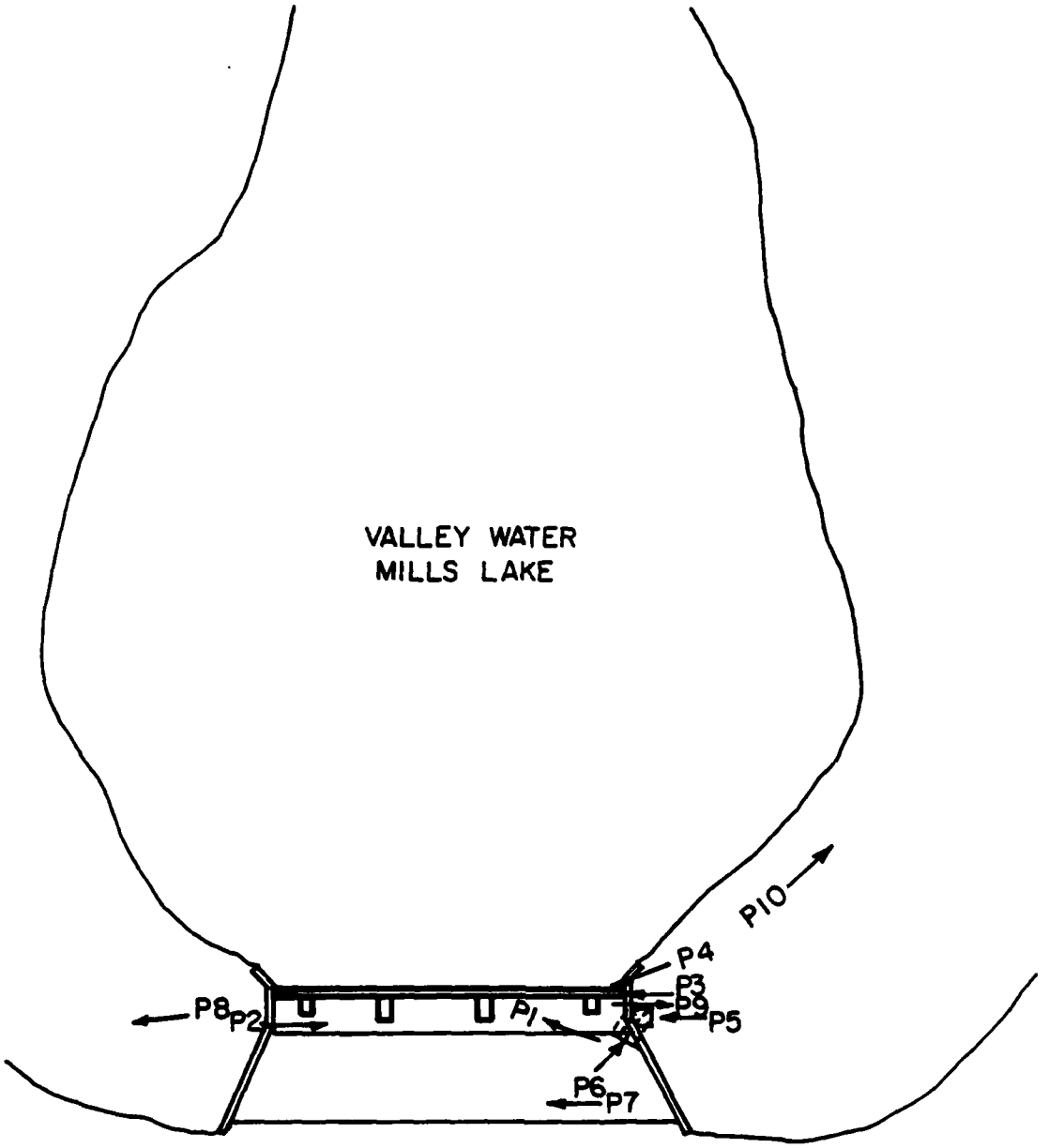
SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	1200.00	1200.00	1203.30
	STORAGE	136.	136.	194.
	OUTFLOW	0.	0.	2014.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	1203.96	.66	206.	2785.	1.17	40.50	0.00
.30	1206.30	3.00	249.	8666.	5.50	40.50	0.00
.50	1207.61	4.31	274.	14434.	6.50	40.50	0.00
.70	1208.70	5.40	295.	20197.	7.00	40.50	0.00
1.00	1210.15	6.85	324.	28888.	12.00	40.33	0.00

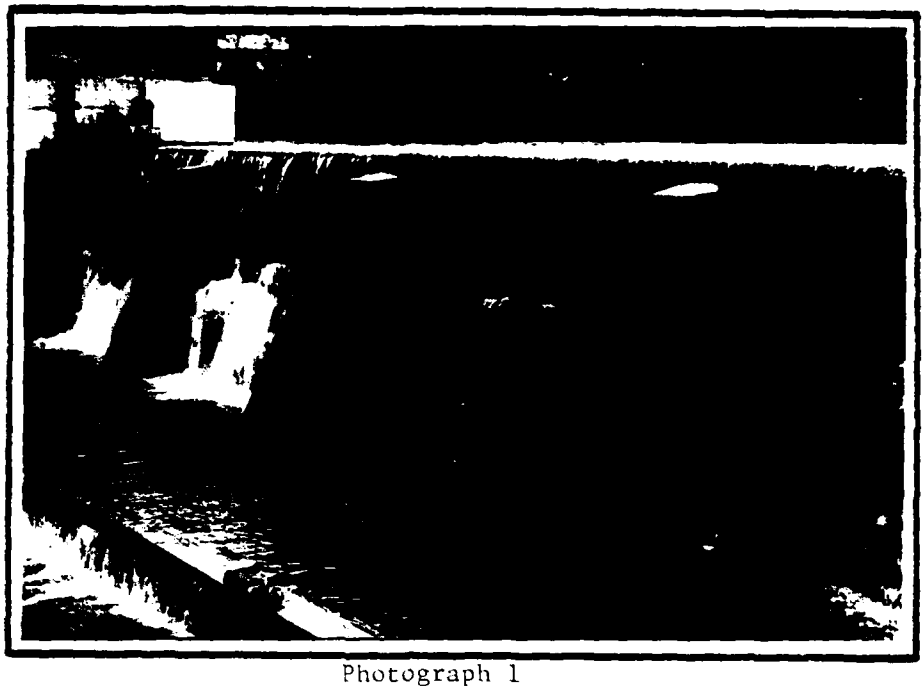
APPENDIX C

PHOTOGRAPHS



P- INDICATES PHOTO LOCATION

VALLEY WATER MILLS DAM
PHOTO INDEX



Photograph 1

Concrete spillway section downstream - Note buttresses and old masonry dam

Photograph 2

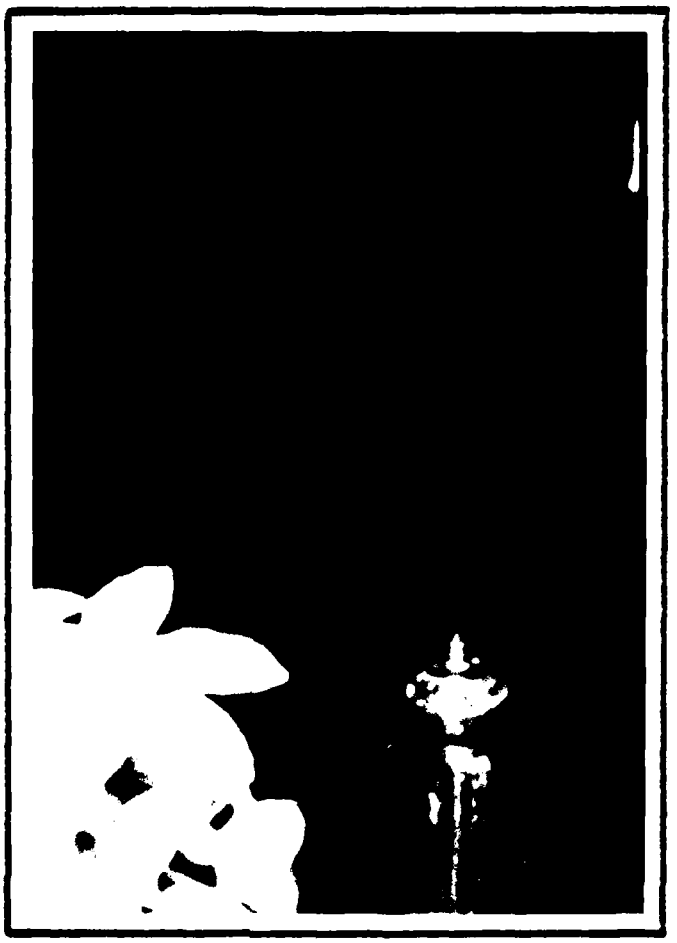
Concrete spillway section and left wingwall

Photograph 3

Concrete spillway section and right wingwall

Photograph 4

Deteriorated left spillway wingwall

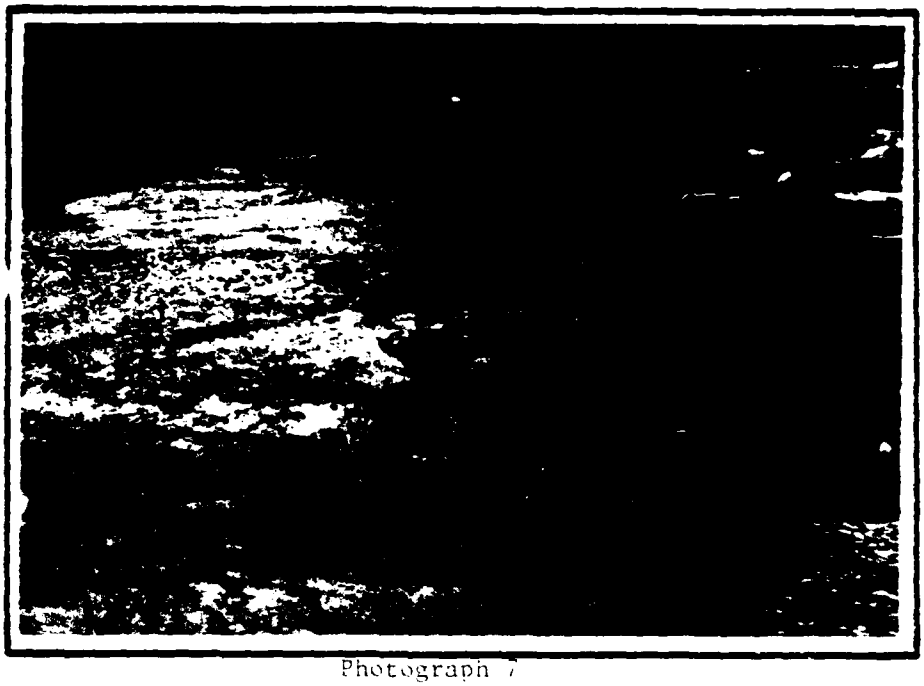


Photograph 5

Valves in valve house

Photograph 6

Pipe outlets



Photograph 7

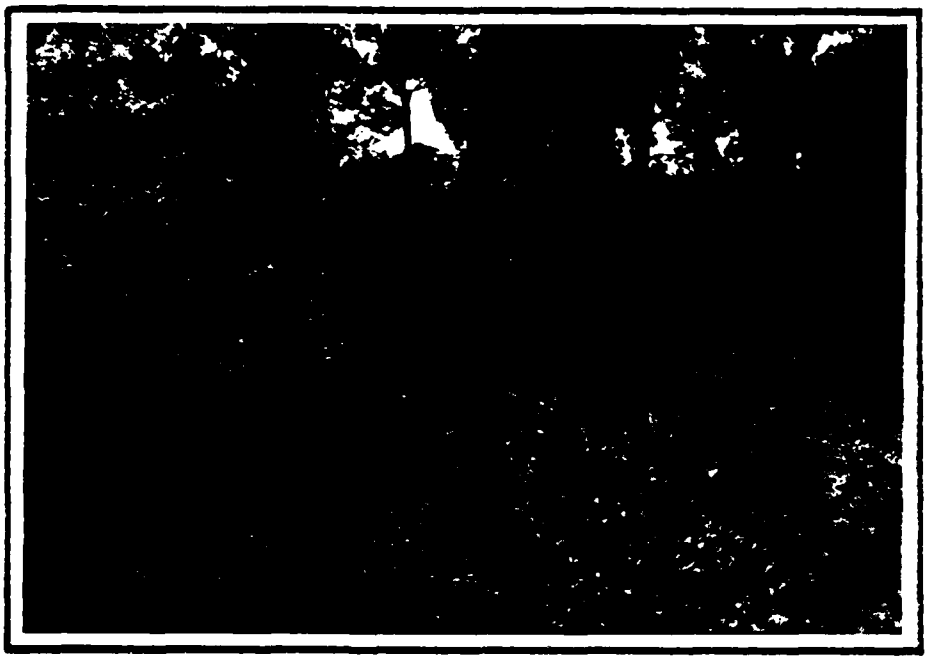
Deteriorated concrete apron

Photograph 8

Downstream slope of right embankment

Photograph 9

Crest and downstream slope of left embankment



Photograph 10

Left abutment